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VACUUM PROCESSING DEVICE

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VACUUM PROCESSING DEVICE

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[There are no amendments to this patent.]

Claims

1. A type of vacuum processing device characterized by the following facts: the vacuum processing device has a vacuum vessel that has wafers or other workpieces contained in it for transportation, a load lock chamber that can be connected to said vacuum vessel for transferring said workpieces between it and said vacuum vessel, and a vacuum processing chamber that is connected via a gate valve to said load lock chamber and is for performing vacuum processing of said workpieces; in this vacuum processing device, there are the following parts: a heater for the vessel main body that heats the vessel main body of said vacuum vessel from the outside, and a heater for lower a plate that heats from the outside the lower plate that can open/close a lower opening of said vessel main body.

2. The vacuum processing device described in Claim 1 characterized by the fact that the vessel main body of said vacuum vessel has a getter material on the inner surface of the vessel main body.

3. The vacuum processing device described in Claim 1 characterized by the fact that said heater for the lower plate is set on a lift table in said load lock chamber, and, at the same time, it is not exposed to the interior of said load lock chamber.

Detailed explanation of the invention

[0001]

Industrial application field

This invention pertains to a type of vacuum processing device. Especially, this invention pertains to improvement of a vacuum processing device that has the following parts: a vacuum vessel that has wafers or other workpieces contained in it for transportation, a load lock chamber that can be connected to said vacuum vessel for transferring said workpieces between it and said vacuum vessel, and a vacuum processing chamber that is connected via a gate valve to said load lock chamber and is for performing vacuum processing of said workpieces.

[0002]

Prior art

In the manufacturing process of semiconductor [devices], before wafers are transported into a semiconductor processing device, and during transportation between two steps of operation, in order to prevent oxidation of the wafer surfaces, according to a proposed scheme, said wafers are contained in a vacuum vessel for storage and transportation.

[0003]

Problems to be solved by the invention

For said vacuum vessel, usually, no baking is performed. Consequently, due to released gas, it takes a long time to reach a high vacuum. This is undesired. Consequently, the wafers are stored and transported while in a low vacuum. As a result, a natural oxide film is formed on the wafers during storage and transportation. This is undesired. Also, during storage and transportation of the wafers, released gas leads to degradation of the vacuum degree in the vacuum vessel, leading to formation of an oxide film on the wafers. This is undesired.

[0004]

The objective of this invention is to solve the aforementioned problems of the prior art by providing a type of vacuum processing device characterized by the fact that it allows the vessel

main body that forms the vacuum vessel and the lower plate that closes the opening portion of the vessel main body to be heated from the outside for baking.

[0005]

Means for solving the problems

In order to realize the aforementioned objective, this invention provides a type of vacuum processing device characterized by the following facts: the vacuum processing device has a vacuum vessel that has wafers or other workpieces contained in it for transportation, a load lock chamber that can be connected to said vacuum vessel for transferring said workpieces between it and said vacuum vessel, and a vacuum processing chamber that is connected via a gate valve to said load lock chamber and is for performing vacuum processing of said workpieces; in this vacuum processing device, there are the following parts: a heater for the vessel main body that heats the vessel main body of said vacuum vessel from the outside, and a heater for a lower plate that heats from the outside the lower plate that can open/close a lower opening of said vessel main body.

[0006]

Also, the vessel main body of said vacuum vessel has a getter material on the inner surface.

Operation of the invention

According to this invention with the aforementioned constitution, there is a heater for the vessel main body that heats the vessel main body of said vacuum vessel from the outside, and there is a heater for a lower plate that heats from the outer side surface the lower plate that can open/close a lower opening of said vessel main body. Consequently, it is possible to bake the entire surface of the vacuum vessel. As a result, it is possible to suppress gas release from the vacuum vessel, and it is possible to realize a high vacuum in a short time of evacuating operation, and, at the same time, it is possible to prevent degradation of the vacuum in the vacuum vessel during storage and transportation of wafers or other workpieces.

[0007]

Also, according to this invention, a getter material is set inside the vacuum vessel. Consequently, even when gas is released within the vacuum vessel, the released gas is chemically adsorbed with the getter material. As a result, degradation of the vacuum degree can be prevented.

[0008]

Application examples

In the following, an application example of the vacuum processing device of this invention will be explained with reference to Figures 1-5. In this application example, wafers are taken as the workpieces for explanation. As shown in Figure 1, the vacuum processing device has vacuum vessel (1) that has the wafers contained in it for transportation, load lock chamber (10) that can be connected to said vacuum vessel (1) and can transfer the wafers between it and vacuum vessel (1), robot chamber (19) that is connected via gate valve (18) to said load lock chamber (10) and is set for robot transfer of the wafers, and a vacuum processing chamber (not shown in the figure) for processing the wafers. Said vacuum vessel (1) is composed of a nearly cylindrical vessel shaped vacuum vessel (2) and lower plate (3) that can open/close the lower opening of said container main body (2). As shown in Figure 2, heating member (4) is set on the outer peripheral surface of vessel main body (2). This heating member (4) is composed of an electrical insulating layer and a heating layer that is formed on the electrical insulating layer and that heats when power is turned ON. Vessel main body (2) and lower plate (3) are made of Al, SUS304, or another nonmagnetic material.

[0009]

Also, getter material (5) is formed on the inner peripheral surface of vessel main body (2). Getter material (5) is a non-evaporating getter material, such as an alloy of 70%Zr-24.6%V-5.4%Fe. The getter material made of said composition has an activation temperature in the range of 400-450°C, and its application temperature is about room temperature to 100°C.

[0010]

Also, on lower plate (3), O-ring (6) for vacuum sealing is set on the contact surface with flange portion (2a) of vessel main body (2). On the upper surface of lower plate (3), wafer carrier (7) that accommodates wafers W in stepwise configuration is fixed. On its lower surface, magnetic member (8) is set.

[0011]

On the other hand, as shown in Figure 1, in the upper portion of load lock chamber (10), sealing part (11) that protrudes to the interior is formed. On the upper surface of said sealing part (11), O-ring (12) is set. Flange portion (2a) of vacuum vessel (1) and O-ring (12) are in close contact with each other to ensure vacuum sealing between vacuum vessel (1) and load lock chamber (10).

[0012]

Also, lift table (14) that is lifted with lift mechanism (13) is set in load lock chamber (10). On the upper surface of lift table (14), O-ring (15) is set, so that the lower surface of said sealing part (11) and the upper surface of lift table (14) are in close contact with each other via said O-ring (15). As a result, when lift table (14) is engaged to sealing part (11) (in the state shown in Figure 1), said load lock chamber (10) is partitioned into upper load lock chamber (10A) and lower load lock chamber (10B). Said upper load lock chamber (10A) is connected via valve V1 to evacuating system (16), and it is also connected via valve V2 to nitrogen source (17). Also, lower load lock chamber (10B) is connected via valve V3 to nitrogen source (17), and it is also connected via valve V4 to evacuating system (16).

[0013]

Also, load lock chamber (10) is connected via gate valve (18) to robot chamber (19).

[0014]

As shown in Figure 3, in the upper portion of said lift table (14), far-IR heater (20) is set. This far-IR heater (20) is covered with light transmissive glass (21) and glass presser (22) that fixes said light transmissive glass (21), so that said heater is not exposed to upper load lock chamber (10A). Said far-IR heater (20) is connected to power source (24) for far-IR via power feeding cable (23) set inside space (14a) in lift table (14) (see Figure 1). O-ring (25) for vacuum sealing is included between light transmissive glass (21) and lift table (14).

[0015]

On the upper surface of said lift table (14), attaching part (26) for attaching lower plate (3) of vacuum vessel (1) is set. As shown in Figure 3, said attaching part (26) has attaching plate (28) that can move up/down via bellows (27), and electromagnet (29) set inside said attaching plate (28) and bellows (27). The upper position of attaching plate (28) is limited by stop (30). Electromagnet (29) is connected via power feeding cable (30) to DC power source (31) for said electromagnet (see Figure 1).

[0016]

Also, internal space (14a) of said lift table (14) is connected to compressed air source (32). By means of the pressure of compressed air fed from said compressed air source (32), said bellows (27) can be extended so that said attaching plate (28) can be raised to the upper position where it is engaged with stop (30). When feeding of the compressed air from said compressed air source (32) is stopped, said bellows (27) retracts under its own rigidity, so that attaching plate

(28) leaves stop (30) and is located at a lower position. Also, bellows (33) is set between the lower portion of lift table (14) and load lock chamber (10) to seal the portion between lift table (14) and load lock chamber (10).

[0017]

In the following, operation of a vacuum processing device with the aforementioned constitution will be explained.

(1) Step of operation of evacuation from atmospheric pressure

Figure 4 is a diagram illustrating an example of the vacuum processing device. Robot chamber (19) is set adjacent to load lock chamber (01) shown in Figure 1. Load lock chamber (35) is set adjacent to said robot chamber (19). Open/close door (36) is set on load lock chamber (35). While lift table (14) is at the raised position, lower load lock chamber (10B) is in a vacuum state, and both vacuum vessel (1) and upper load lock chamber (10A) are at atmospheric pressure. Lower plate (3) having wafer carrier (7) with no wafers fixed on it is set on attaching part (26), and electromagnet (29) is turned ON to attach lower plate (3). Vessel main body (2) is set on sealing part (11) of load lock chamber (10), and wafer carrier (7) is accommodated in vessel main body (2), while vessel main body (2) is pressed with a pressing means not shown in the figure. Then, valve V1 is opened, and upper load lock chamber (10A) at atmospheric pressure is evacuated.

[0018]

Then, lift table (14) is lowered, so that lower plate (3) and wafer carrier (7) are positioned in load lock chamber (10). Heating body (4) and far-IR heater (20) are turned ON to heat vessel main body (2) and lower plate (3) from the outside for baking of vessel main body (2), lower plate (3) and wafer carrier (7). In this case, because the regeneration temperature of the getter material is near the baking temperature, no special regeneration heater or the like is used, and while baking is performed, regeneration of getter material (5) on the inner surface of vessel main body (2) is performed. Then, heating member (4) and far-IR heater (20) are turned OFF, and baking comes to an end.

[0019]

On the other hand, door (36) is opened, and cleaned wafers W are loaded in load lock chamber (35) with wafer carrier (40), and valve V5 is opened and evacuating system (37) is turned ON to evacuate the interior of load lock chamber (35). Then, gate valves (18) and (38) are opened, so that the two load lock chambers (10), (35) are connected to each other. Then, robot

(19a) in robot chamber (19) is turned ON, so that wafers W in load lock chamber (35) are sequentially transferred to wafer carrier (7) in load lock chamber (10). After completion of the transfer, said two gate valves (18), (38) are closed and lift table (14) is raised, so that load lock chamber (10) is partitioned into upper load lock chamber (10A) and lower load lock chamber (10B). While compressed air is fed from compressed air source (32) to internal space (14a) of lift table (14), attaching plate (28) of attaching part (26) is raised to the upper position. Then, the pressure in upper load lock chamber (10A) is brought back from vacuum to atmospheric pressure. Then, electromagnet (29) is turned OFF, and feeding of the compressed air to internal space (14a) of lift table (14) is stopped, so that attaching plate (28) of attaching part (26) is lowered. Then, vacuum vessel (1) is transported to another processing device. During the transportation process, gas molecules that enter the interior of the vessel due to degassing from within the vessel and from leakage are adsorbed with the regenerated getter material inside the vessel, so that degradation in the vessel is prevented.

[0020]

(2) Step of operation from vacuum to vacuum

Figure 5 is a diagram illustrating another example of the vacuum processing device. Robot chamber (19) is set adjacent to the load lock chamber shown in Figure 1. Vacuum processing chamber (39) is set adjacent to said robot chamber (19). While lift table (14) is in the raised position, lower load lock chamber (10B) is in a vacuum state, upper load lock chamber (10A) is at atmospheric pressure, and the interior of vacuum vessel (1) is in a vacuum state. When compressed air is fed from compressed air source (32) to internal space (14a) of lift table (14), attaching plate (28) of attaching part (26) is raised, and vacuum vessel (1) having wafers W in it is carried on attaching part (26). After electromagnet (29) is turned ON, and lower plate (3) is attached to attaching plate (28), feeding of the compressed air is stopped, so that attaching plate (28) descends to the lower position, and flange portion (2a) of vessel main body (2) is carried on the upper surface of sealing part (11). Then, valve V1 is opened so that the pressure in upper load lock chamber (10A) is brought from atmospheric pressure to a vacuum. Then, compressed air is fed to internal space (14a) of lift table (14), and attaching plate (28) is raised to the upper position. Then, lift table (14) is lowered, and robot (19a) transfers wafers W from carrier box (7) into vacuum processing chamber (39). After completion of transfer, lift table (14) is raised, and the pressure in upper load lock chamber (10A) changes from vacuum to atmospheric pressure. Electromagnet (29) of attaching part (26) is turned OFF, and feeding of compressed air to internal space (14a) is stopped, so that attaching plate (28) of attaching part (26) descends. Then, empty vacuum vessel (1) is transported.

[0021]

(3) Step of operation from vacuum to atmospheric pressure

While lift table (14) is at the raised position, lower load lock chamber (10B) is in a vacuum state, upper load lock chamber (10A) is at atmospheric pressure, and the interior of vacuum vessel (1) is in a vacuum state. Attaching plate (28) of attaching part (26) is raised and vacuum vessel (1) containing wafers W is carried on attaching plate (26). Electromagnet (29) is turned ON, and attaching plate (28) of attaching part (26) descends. With a pressing means not shown in the figure, vacuum vessel (1) is pressed, vacuum sealing (12) is applied, valve V1 is opened, and the pressure of upper load lock chamber (10A) is changed from atmospheric pressure to a vacuum. After lift table (14) is lowered together with lower plate (3), lift table (14) is raised again. In this case, a certain spacing is formed between lower plate (3) and vessel main body (2). While the pressure of upper load lock chamber (10A) is changed from a vacuum to atmospheric pressure, the pressure inside vacuum vessel (1) is also changed to atmospheric pressure. Electromagnet (29) of attaching part (26) is turned OFF, and vacuum vessel (1) is transported.

[0022]

Also, in this application example, while upper load lock chamber (10A) and lower load lock chamber (10B) are connected via valves V2, V3 to nitrogen source (17), dry clean nitrogen is fed into the chamber, so that a clean state is maintained. Also, in this application example, heating member (4) is set on vessel main body (2) as a heater for vessel main body (2). However, it is also possible to set the heater at a position separated from vessel main body (2). Also, a ribbon heater or the like may be used. In this application example, a conventional O-ring is used for vacuum sealing. However, one may also use a metal seal or the like for vacuum sealing.

[0023]

Effect of the invention

As explained above, according to this invention, a heater for heating the vessel main body of the vacuum vessel from the outside and a heater for the lower plate, which can open/close the lower opening of the vessel main body, from the outside are prepared. Consequently, it is possible to bake the entire surface of the vacuum vessel. Consequently, according to this invention, it is possible to suppress gas release from the vacuum vessel, and a high vacuum can be realized in a short time. At the same time, gas release during wafer storage and transportation is suppressed, and generation of an oxide film on wafers can be prevented.

[0024]

Also, according to this invention, a getter material is set inside the vacuum vessel. Consequently, even when gas is released in the vacuum vessel, the gas is chemically adsorbed with the getter material. As a result, degradation of the vacuum degree can be prevented. In addition, regeneration of the getter material can be performed simply without any special means while baking the vessel.

Brief description of the figures

Figure 1 is a cross-sectional view illustrating an application example of the vacuum processing device of this invention.

Figure 2 is a cross-sectional view illustrating in detail the vacuum vessel of the vacuum processing device in this invention.

Figure 3 is a cross-sectional view illustrating in detail the load lock chamber and the lower plate of the vacuum processing device in this invention.

Figure 4 is a diagram illustrating an example of use of the vacuum processing device of this invention.

Figure 5 is a diagram illustrating an example of use of the vacuum processing device of this invention.

Explanation of the figures

1	Vacuum vessel
2	Vessel main body
3	Lower plate
4	Heating member
5	Getter material
7	Wafer carrier
8	Magnetic member
10, 35	Load lock chamber
11	Sealing part
14	Lift table
16	Evacuating system
18, 38	Gate valve
19	Robot chamber
20	Far-IR heater
21	Light transmissive glass
24	Power source for far-IR

26 Attaching part
27 Bellows
28 Attaching plate
29 Electromagnet
39 Vacuum processing chamber
40 Wafer carrier

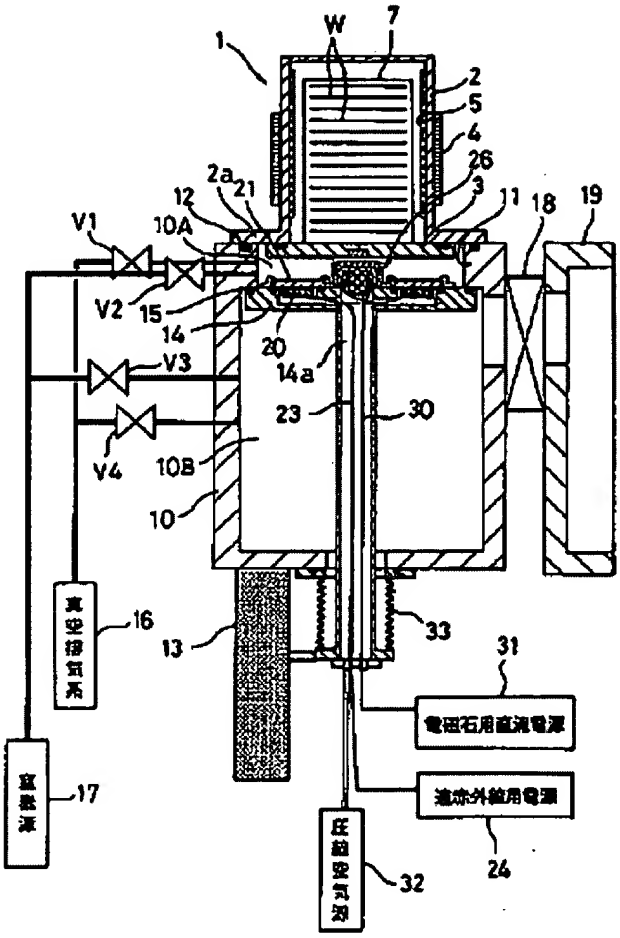

Figure 1

Key: 16 Evacuating system
17 Nitrogen source
24 Power source for far-IR
31 DC power source for electromagnet
32 Compressed air source

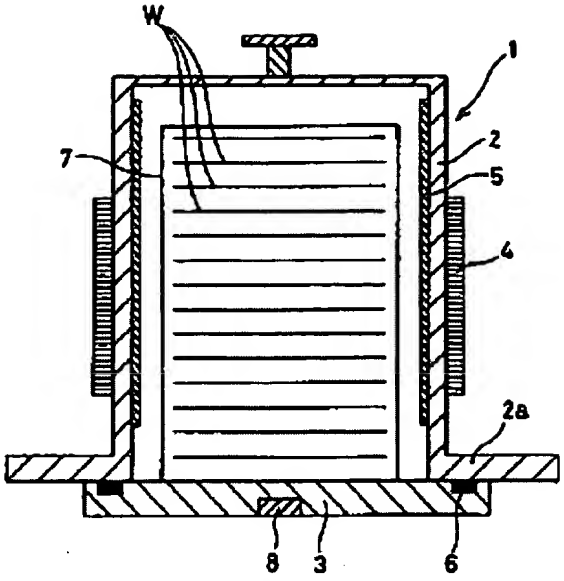

Figure 2

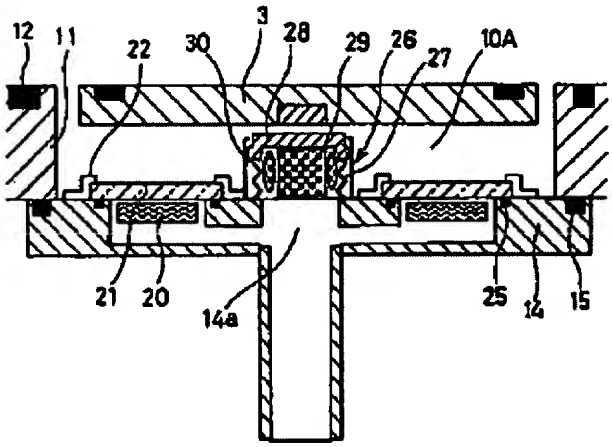

Figure 3

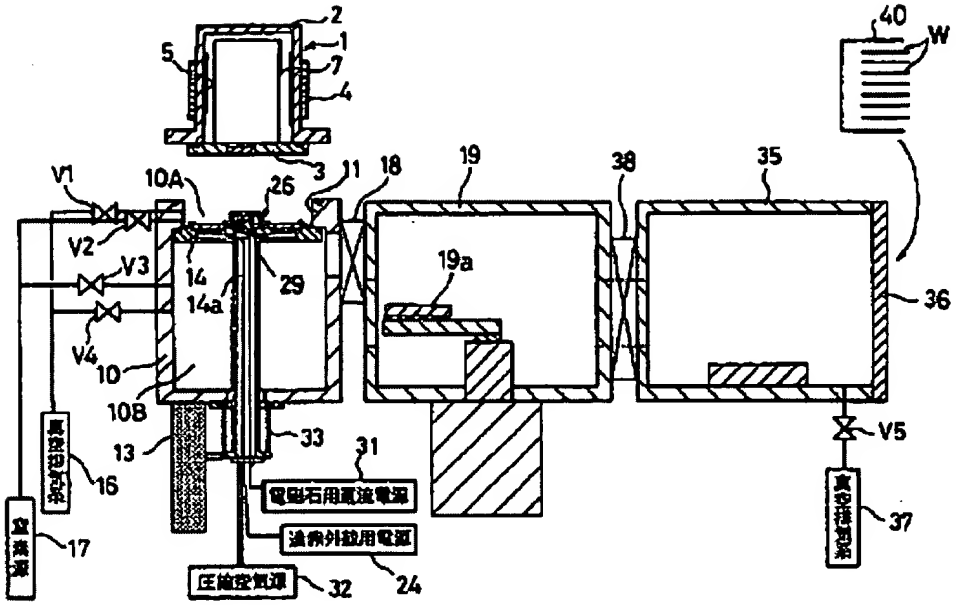

Figure 4

Key:
16 Evacuating system
17 Nitrogen source
24 Power source for far-IR
31 DC power source for electromagnet
32 Compressed air source
37 Evacuating system

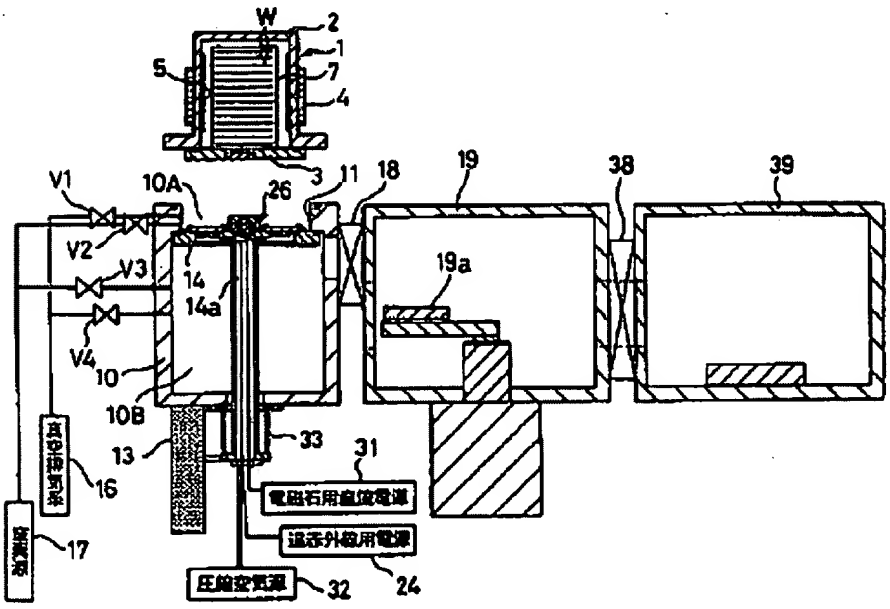

Figure 5

Key:
16 Evacuating system
17 Nitrogen source
24 Power source for far-IR
31 DC power source for electromagnet
32 Compressed air source